

Costs of Raising (Social) Capital Through Mini-Bonds

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Public officials use mini-bonds, small denomination municipal bonds, as a mechanism to broaden citizen access to tax-exempt investments that finance public infrastructure. Marketing debt securities to smaller investors comes with costs, but a popular expectation is that such offerings strengthen local social capital. This paper provides a historical overview of the use of mini-bonds, including the rationale and challenges. It then uses a series of mini-bond issuances by the City and County of Denver from 1990 to 2014 to illustrate the differences in issuance and interest costs compared to traditional municipal bonds, as well as investor access outcomes. A series of considerations for public officials contemplating the issuance of mini-bonds is included. Mini-bonds present a conscious financing decision where the additional and substantial costs can be quantified, but the anticipated benefits of increased publicity about public projects and more equitable investor access are more difficult to value.

INTRODUCTION

Tax-exempt municipal bonds are a primary source of long-term financing for state and local governments. Traditionally, such bonds are sold in \$5,000 increments and are especially desirable to high-income investors, because they receive relatively greater financial benefit from the tax-exempt interest. Issuing municipal bonds is costly and requires the assistance of a wide range of financial intermediaries. These costs of issuance decline, as a percentage of the funds raised, with increases in the amount of debt issued. Governments respond to these factors by structuring municipal bond issuances to reduce costs—for example, by borrowing only periodically to benefit from scale economies—and traditionally use underwriters to market the bonds to investors.

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Contrary to these facts, governments periodically issue small-denomination bonds directly to the public through “mini-bonds.”¹ Mini-bonds are not a new phenomenon, but they run counter to many of the rules about how governments should raise capital in a cost-effective manner. Given that public officials and their advisors are aware of these inefficiencies, they must perceive significant nonfinancial benefits in mini-bond issuance. Indeed, mini-bonds are touted as a financing method that can better connect taxpayers to the public projects they approve at the ballot box. Public officials use mini-bonds to engage citizens, increase citizens’ access to municipal bonds, increase the perceived equity of tax-exempt financing, and increase social capital while funding capital projects. These functions rival the capital-raising role of mini-bonds, which is often limited in scale due to the number of small retail buyers and the expectation of higher borrowing costs.

The decision to use mini-bonds is political, but we know little about the additional costs or benefits of the decision. This study is, to our knowledge, the first empirical work focused exclusively on mini-bonds.² This lack of attention is likely explained by mini-bonds’ relatively small share of the municipal bond market. Renewed academic focus is warranted by the high levels of public and media interest in the practice and the potential for mini-bonds to broaden the narrow function of borrowing to include the development of social capital.

This paper quantifies the associated costs and considers the anticipated benefits of historical mini-bond issuances by the City and County of Denver, Colorado. Specifically, it addresses three research questions considering the cost, benefits to local residents, and improved investor access to mini-bonds:

1. How much more expensive is debt financing with mini-bonds than with traditional municipal bonds?
2. Are mini-bonds an effective way to get municipal debt into the hands of more local residents?
3. Do mini-bonds improve the ability of nontraditional investors to access municipal bonds?

This paper begins with background on mini-bonds and the rationale for their use and reviews their inherent challenges. It then considers the role of the public in public debt finance based on existing research and presents

¹ In this paper, mini-bonds refer to municipal securities issued by public entities. The emerging practice of raising capital for private companies, often start-ups, through crowd-funding has more recently been referred to as mini-bonds (Espinoza, 2015).

² A recent article by Fu (2016) provides a useful overview of mini-bond experiences in Denver, Colorado, and Vancouver, Washington, but does not analyze the associated costs.

our data sources and research design. The paper concludes with a review of the results and the implications for governments considering mini-bonds.

To preview our findings based on the Denver experience, the additional costs of mini-bonds are substantial, especially when compared to the principal they raise. Mini-bond issuance costs as a share of principal raised are 2.5 to 7.8 times higher than traditional municipal bond issuance costs for the five Denver mini-bond experiences. Increased issuance costs are unsurprising given the scale economies present in tax-exempt debt issuance. These figures, though, fail to consider the additional internal staff costs associated with the infrequent use of mini-bonds. Interest rates are ultimately more critical for the costs of raising capital. The mini-bonds consistently experienced higher interest rates than traditional municipal bonds issued under the same voter authorization. The differences in interest rates between mini-bonds and similarly authorized traditional general obligation (GO) bonds varied across the issuances. The total additional costs incurred by mini-bonds averaged 21% of the mini-bond principal raised. High investor demand, often exceeding initial expectations (Racine, 1990b; Williamson, 2014), is frequently interpreted as a sign of a successful mini-bond issue, rather than a reflection of overly generous interest rates.

We provide a preliminary look at whether these higher costs of mini-bonds are justified by the stated policy goals of their supporters. In Denver's last two mini-bond issuances, most purchases were made by Colorado residents outside of the City and County of Denver itself. In 2007 and 2014, only 35% and 32%, respectively, of purchases were by Denver residents. Despite lower denominations (\$333 to \$500) for mini-bonds, the average purchase amount exceeded the standard \$5,000 municipal bond denomination in four of the five issuances. In 2007 and 2014, mini-bond purchases averaged \$11,506 and \$14,118, respectively, suggesting that much of the mini-bond principal was purchased by relatively large buyers that may be able to access the traditional municipal bond market in other ways.³

BACKGROUND ON MINI-BONDS

A range of state and local governments, including public authorities, has issued mini-bonds. The history of small-denomination bonds in the United States can be traced back to the late 1800s, when New Orleans used \$20-denominated bonds, and saw erratic resurgence in the practice in subsequent years (Moak, 1970). A notable example, detailed by Moak

³ It is debatable whether all broker-dealers would be interested in selling even \$10,000 to \$15,000 in bonds to individual investors, but such purchases can be made through online trading systems or mutual funds.

(1970, p. 278), includes legislation approved in Pennsylvania at the behest of organized labor in 1969 “requiring that a ‘reasonable’ proportion of future bond issues by state and local governments be in \$100 denominations.” An early user of mini-bonds was the City of Milton-Freewater in Oregon, which in 1981 issued \$45,000 in what was called a “citizen bond sale” (The Bond Buyer, 1981). As of 1990, larger cities, including Boston, Denver, Eugene, and Phoenix, among others, had used mini-bonds (Racine, 1990a).

When the practice reemerged in the early 1990s, James Lebenthal of Lebenthal & Co. pushed for approaches to lower the marketing costs of mini-bonds, such as pooling insured mini-bonds across issuers. Lebenthal commented on the need to modify mini-bonds to support their popularization, stating: “When they first mass produced chairs, they poured the chair into a mold. We have to pour muni bonds into a new mold if we are going to mass market them to the people” (Kalish, 1992). The direct marketing of municipal bonds in smaller increments remains salient. For example, California passed a law in 2011 to decrease the minimum GO bond denomination from \$1,000 to \$25 (Jensen, 2011b). Since 2014, Massachusetts has offered investors the opportunity to purchase state GO bonds online through MassDirect Notes (with preference given to in-state individuals). Alternately, private start-ups, such as Neighborly, are working to improve the ability of individuals to invest in and support local capital projects outside of the existing municipal bond market structure (Boss, 2016).

Characteristics of Mini-Bonds

The defining characteristic of mini-bonds is the availability of small denominations for purchase by individual investors. Other factors further differentiate them from traditional municipal bonds (see Table 1 for a summary of the distinguishing characteristics). The denominations differ but are typically well below the traditional \$5,000 amount. Mini-bonds are usually structured as zero-coupon bonds whereby the bonds are issued at a large original discount to face value and no interest payments are made prior to payment at maturity. Mini-bonds are generally tax-exempt, although portions of past issuances have been taxable (Kalish, 1992).

Unlike traditional municipal bonds, mini-bonds are marketed directly to individuals without an underwriter serving as broker-dealer. Instead, a firm plays the role of the processing agent to support the sale and then as placement agent in maintaining the transaction records and executing the payments required at maturity. The underwriters’ discount is historically the largest portion of the issuance costs for municipal bonds (Peng, Kriz, and Neish, 2008). Mini-bonds incur additional marketing costs that offset some of the underwriter savings. Mini-bonds require direct marketing, including promotional content in print and multimedia formats (more

Table 1: Characteristics of Traditional Municipal Bonds and Mini-Bonds

	Traditional Municipal Bonds	Mini-Bonds
Payment type	Current interest bonds	Zero coupon bonds ^a
Minimum denomination	\$5,000	< \$5,000 (often less than \$1,000)
Issuance process	Underwriter	Processing/placement agent
Size of issue	Limited by investor demand	Limited by individual investor demand
Geographic restrictions	None ^b	Typically limited to state residents
Maximum purchase amount restrictions	None	Maximum purchase amounts (for example, \$20,000 per person or household)
Maturities	Typically up to 40 years	Shorter maturities
Credit backing	General obligation, revenue, certificates of participation	General obligation

^a Although typically zero-coupon bonds, mini-bonds are also issued as current interest bonds. A prominent example is a portion of the mini-bonds offered through Santee Cooper, South Carolina's public electric and water utility.

^b In most states, preferential state income tax treatment of in-state tax-exempt bonds provides incentives for purchase by state residents.

recently online), the purchase of newspaper advertisements, direct mailings, and investor hotlines. Structuring mini-bonds so that the payment upon maturity doubles the initial purchase price (or increases it by half, two-thirds, or triple in some cases) is a common, although not required, component of marketing mini-bonds to individual investors.

The focus on individual investors means mini-bonds have relatively short maturities compared to traditional municipal bonds. For example, maturities for Denver's five mini-bond issues ranged from nine to 15 years. Mini-bonds are also typically GO credits, which makes them less risky than other forms of credit backing. In addition to influencing the characteristics of the debt itself, policies that accompany mini-bonds impose restrictions on potential investors. These take two primary forms. First, issuers place geographic restrictions on mini-bond purchasers—most commonly they must be a resident of the state where the sale is taking place. Second, in order to honor the spirit of a mini-bond sale and support improved access for small investors, buyers are often restricted in the total amount of mini-bonds they may purchase. These restrictions allow a larger number of individual buyers access to the bonds. A June 2015 mini-bond issue by Vancouver, Washington, limited buyers to \$10,000 per household (City of Vancouver, 2015). Other mini-bonds establish different limits that apply to either individuals or households.

Rationale and Challenges for Mini-Bonds

Mini-bonds are used in lieu of traditional municipal bond financing for a variety of reasons. The primary rationale for mini-bonds is to capitalize on the connection between residents, their government, and its capital projects. Discussing mini-bonds, New York City's former mayor David Dinkins noted that "the capacity of persons to purchase a bond gives them a feeling and an attitude of having a piece of our city and thereby a far superior attitude and wholesome attitude about the city" (Doran, 1992). This objective, whereby citizens gain tangible ownership of government projects and cooperate to produce public goods, is characterized as an effort to enhance social capital. Having citizens invest in their government is expected to yield benefits to the local government and governance (Martell, 2010). Mini-bonds have even been promoted as a way to demonstrate patriotism (Jensen, 2011a) and enhance government employee morale (Finestone, 2001).

Providing easier access to such investment opportunities for residents strengthens the link between citizens and government in a way that is different from other methods of public participation. A Department of Revenue official in Denver focused on the access issue, commenting that Denver "wanted a way to enable the average citizen, the everyday Joe, to participate in financing public infrastructure" (Watts, 2007). In the case of mini-bonds, local citizens are actually providing the financing for visible and often popular public projects and simultaneously being repaid with their own tax dollars. Mini-bonds, in addition to theoretically broadening access to municipal securities, also eliminate concerns for buyers over advantageous pricing received by institutional investors (GAO, 2012), because there is no spread or commission with the direct sale.

Mini-bonds also generate publicity in a manner unlike traditional municipal bond financing. A Denver banker observed that: "There's some public relations benefit to a government doing minibonds, but that's all there is to them" (Moore, 2000). The use of mini-bonds, like all public debt, requires approval of the elected governing body (a city council, for example), but the resulting publicity can be perceived as a source of political gain. An example of the political tension that can arise with the use of mini-bonds comes from New York State. In 1994, some politicians reacted negatively to the proposed use of Governor Mario Cuomo in the marketing of mini-bonds. A state assemblyman remarked that such a marketing role for the Governor would amount to "a new method of campaign financing" (Gasparino, 1993).

The political nature of mini-bonds also surfaces in response to their costs. The use of mini-bonds with relatively generous interest rates is problematic if elected officials provide outsize gains to a small segment of voters at the expense of the broader residents. The aforementioned New York deal, which raised nearly \$55 million, came under scrutiny for its higher

costs from a candidate for state comptroller (Gasparino, 1994). Specifically, Assemblyman Faso argued that the Governor’s New York Savings Bond Program resulted in almost \$4 million of additional costs due to “unnecessary insurance, interest, and promotional expenses compared to a more conventional tax-exempt issue” (Gasparino, 1994).

Issuance Cost Expectations

The primary barrier to mini-bonds is the endemic higher costs of issuance due to limited scale economies. Although an underwriter is not required, the issuance of mini-bonds continues to demand the remaining professional services that support a traditional tax-exempt bond offering. As mentioned, a primary difference in issuance costs is the need for marketing to let citizens know about the bonds. Marketing is especially important the first time a government uses mini-bonds and the investment is unfamiliar. A marketing firm, for example, conducted an \$80,000 campaign to understand how to attract resident buyers in Denver’s first mini-bond sale (Racine, 1990a). Even with today’s technology, there are additional costs to selling directly to the public. Without an off-the-shelf platform to support mini-bonds, Denver, for example, “had to start from scratch” to create the infrastructure for online sales by working with an existing banking partner (Cortese, 2015). Bringing traditional municipal bonds to market requires internal government resources, such as staff time (Pohle, 1991), but these internal costs are likely more significant with mini-bonds due to their infrequent use, need for marketing, and focus on individual investors.

Historically, higher administration costs for mini-bonds resulted from recording and tracking a large number of small owners over the life of the mini-bonds. A 1992 letter to the editor in *The Bond Buyer* titled “To Even Consider Mini-bonds Is Insane,” addressed mini-bond costs and the logic of marketing municipal bonds to small, nontraditional investors (Harris, 1992). One bond broker associated with mini-bonds notes that: “They’re a pain in terms of the people administering them—city people, brokers, auditors” (Moore, 2000). One minor example is that mini-bond investors were prone to losing the physical certificates before maturity, which requires issuing new certificates (Hattori, 1993). Improvements in technology have made such cumbersome record-keeping less problematic, but have not eliminated issues like dealing with lost certificates or the need to reassign the bonds in the event of the death of the owner or a court ruling. Alternately, the zero coupon structure of the bonds serves to reduce the typical transaction costs of semi-annual interest payments (Petersen, 1982).

Interest Cost Expectations

A fundamental concern about mini-bonds is whether mini-bond interest rates need to be relatively inflated based on their unique characteristics.

Indeed, there are a number of mini-bond traits that may require additional investor compensation and others that may reduce interest rate levels.

First, mini-bonds are typically illiquid, with no available secondary market for investors to sell the bonds before maturity, which may result in higher interest rates. This issue is more general, as even small positions in traditional municipal bonds lack liquidity in secondary markets (GAO, 2012).

Second, zero coupon bonds do not pay periodic interest, so interest rates will be higher or lower than current interest bonds depending on the expected direction of market rates (Petersen, 1982). For example, the spread between zero coupon bonds and current interest bonds reportedly widens at times of low interest rates (Lindvall, 2008). According to Petersen (1982), zero coupon bonds resulted in substantial interest cost savings during the early 1990s. These reported savings were reflected in some mini-bond issuances of the time. For example, New York City reportedly saved \$2.2 million on the sale of \$100 million of mini-bonds in the early 1990s with lower interest rates than its traditional GO bonds (Kalish, 1992). This is limited evidence that relatively high interest rates are not required for mini-bonds. The lack of periodic interest payments associated with zero coupon bonds also limits the potential investor pool to those without the need for current investment income (Petersen, 1982). Additional compensation in the form of higher interest may be needed to entice additional buyers.

Third, and related, there is no call option on zero-coupon mini-bonds, so the investor does not shoulder the reinvestment risk associated with callable bonds, and lower interest rates are expected (Petersen, 1982). Mini-bond maturities are relatively short, however, so the call option is less relevant.

Fourth, mini-bonds are marketed to investors who do not currently access the traditional municipal bond market. If these targeted buyers have lower incomes than traditional municipal bond buyers, then they benefit less from the tax exemption based on an investor's marginal income tax rate. In other words, lower-income mini-bond buyers require a higher tax-exempt interest rate than do wealthier buyers for after-tax returns to equal taxable bond returns. Concerning a Denver mini-bond issue, one investment professional doubted whether "investors who buy bonds in \$500 increments would need the tax benefits of municipal bonds" (Preston, 1999).

Finally, many issuers package mini-bonds so the investment multiplies by a set amount that is easy for individual investors to understand. This structure may also influence the interest rate independent of market rates. Prior to a mini-bond issue in Denver in 2007, the director of financial management provided some insight into this rate-setting process, noting that: "When we market the minis, we will figure out what the market

interest rates are, and determine a maturity date 10 to 15 years out. If an investor pays \$500, for instance, he might get \$1,000 when the mini-bond matures” (Albanese, 2006). It is unclear whether individual investors respond more to the social capital nature of the mini-bond investment or to the return.

THE PUBLIC IN PUBLIC DEBT

Mini-bonds are mentioned only briefly in the existing academic literature, with discussion focused on the novelty and challenges of such financing. In 1970, Moak observed that: “It is too early to tell whether the mini-bond offers real potential” (p. 278). Hildreth (1987) later comments that the economics of mini-bonds “have not been proven yet” (p. 327). Lessons on mini-bond issuance appeared in *Government Finance Review’s* “State of the Art” section in 1991 (Pohle, 1991). Nearly a decade later, Lee and Johnson mention that mini-bonds are inappropriate for raising large amounts of funds but “have proved popular for financing smaller projects that especially interest local residents” (1998, p. 383).

The broader academic literature is relevant for understanding the use of mini-bonds, especially as it pertains to government efforts to engage the public. Citizen engagement and public participation in debt financing is limited. The primary nexus of citizens and the decision to borrow for public projects is the bond referendum, where voter approval is required to authorize the issuance of local debt in the majority of states (ACIR, 1993). Such bond referendums help determine the quality and availability of public infrastructure. A secondary, less direct, connection between citizens and long-term financing for capital projects is the existing budget process and its public hearings (Ebdon and Franklin, 2006). In practice, although the decision to move forward with a capital project is often political, the financing method is typically an administrative decision based on the merits of the available alternatives. Some research even suggests that governments attempt to limit the role of the public in financing decisions, because some forms of debt circumvent referendum requirements (Simonsen and Hill, 1998). In addition, the public in a given state is already incentivized to play the part of investor (or lender) in response to the tax preferences afforded to in-state ownership of tax-exempt debt. The use of mini-bonds to strengthen the link between citizens and public projects is quite different from traditional roles of the public in capital finance. More broadly, the engagement of citizens as investors in visible public projects using mini-bonds reflects the belief that such engagement provides tangible benefits, including improved citizen expectations for good governance and fiscal discipline, and better alignment of citizen needs and project selection (Martell, 2010).

CASE STUDY METHODOLOGY AND DATA

The City and County of Denver is unique in its repeated use of mini-bonds over the past 25 years.⁴ This history guides the selection of Denver as the case study setting. Denver issued mini-bonds five times, in 1990, 1992, 1999, 2007, and 2014, across different interest rate environments and mayoral administrations (Federico Peña, Wellington Webb, John Hickenlooper, and Michael Hancock). The issues varied in size (ranging from \$3.1 million in 1999 to \$12 million in 2014), maturity (15 years being the longest in 1990 and nine years the shortest in 2014), the use of tranches (only in 1990 and 2014), and the payoff amount relative to the initial investment (the highest was 200% growth in 1990, the most common was a doubling, and the lowest growth of principal was a 50% increase for one tranche in 2014). The most recent mini-bond experience also frames our research questions, as Denver's chief financial officer noted that: "It costs the city a little more to run a mini bond program and bring individual investors in," but "we were willing as a city to pay that additional premium" (Murray, 2014). A proponent of mini-bonds on the city council raised the policy objectives stating that: "It's always been important to me to allow citizens to invest themselves in the projects they approve. . . . Otherwise, they're just on the payor end. I want them to get some of the interest" (Murray, 2014). Table 2 provides a detailed comparison of the five different mini-bond experiences in Denver.

Background information on each issue was gathered using media coverage, city council meeting minutes and recordings, archival resources, and a series of key participant interviews, representing the city and county's

Table 2: City and County of Denver Mini-Bond Characteristics, 1990–2014

Year	Principal Amounts	Rate	Increase at Maturity (%)	Purchase Denomination	Maturity Amount	Years Outstanding
1990	\$4,084,500	7.10%	100%	\$500	\$1,000	9.94
	\$1,803,982	7.35%	200%	\$333.33	\$1,000	15.24
1992	\$3,991,500	6.00%	100%	\$500	\$1,000	11.73
1999	\$3,133,500	4.75%	100%	\$500	\$1,000	14.78
2007	\$8,860,500	4.75%	100%	\$500	\$1,000	14.78
2014	\$6,000,000	4.38%	50%	\$500	\$750	9.35
	\$6,000,000	4.89%	100%	\$500	\$1,000	14.36

⁴ Other types of governments have also been repeat issuers of mini-bonds. South Carolina, for example, issued mini-bonds in 1994, 1995, 1999, and 2000 and Santee Cooper, a South Carolina public utility, has regularly used mini-bonds over the past decade.

Department of Finance, as well as the financial advisor, placement and processing agent, and marketing team for the mini-bond offering in 2014. The characteristics and costs of the mini-bond issues came from official statements provided by Denver’s Department of Finance.⁵ To answer our primary research question about the additional costs of using mini-bonds, we use the official statement to determine the issuance and interest costs of each mini-bond issue. When there were multiple tranches, the internal rate of return was calculated to determine the interest cost for the mini-bond issue as a whole (see description below).

A credible counterfactual is used to determine the difference in direct costs (both issuance and interest) associated with Denver’s mini-bonds. We assume that the funds raised through mini-bonds could have been raised through Denver’s traditional GO bond offerings authorized by the same popular vote. The official statements for the comparison GO bonds are collected through the Municipal Securities Rulemaking Board’s Electronic Municipal Market Access (EMMA) system (see traditional GO bond characteristics in Table 3). For the traditional bonds, costs of issuance are

Mini-Bond Year Comparison	Year/Series	Principal Amount	Final Maturity Year	Election Year(s) Authorized	Interest Rate (IRR)	Issuance Costs	Issuance Costs (% Principal)
1990	1990	\$74,000,000	2005	1989	6.89%	\$687,000	0.93%
	1991	\$84,460,000	2006	1989 & 1990	6.25%	N/A	N/A
1992	1992A	\$65,000,000	2007	1989 & 1990	5.68%	N/A	N/A
	1992C	\$100,000,000	2007	1989 & 1990	5.56%	N/A	N/A
1999	1999B	\$95,505,000	2008	1998	4.52%	N/A	N/A
2007	2005	\$77,000,000	2025	1999 & 2005	4.09%	\$490,590	0.64%
	2006	\$125,000,000	2025	2005	3.94%	\$665,473	0.53%
	2008	\$174,135,000	2025	2005	3.46%	\$832,926	0.48%
2014	2009A	\$118,915,000	2025	1999 & 2007	3.81%	\$804,945	0.68%
	2011A	\$16,455,000	2025	2007	2.90%	\$300,009	1.82%
	2013A	\$120,925,000	2030	2007	2.06%	\$475,807	0.39%

Sources: Office of the Auditor (2009). *Building a Great City with Borrowed Money: An Historical Overview of Denver’s General Obligation Debt*. City and County of Denver Office of the Auditor, Division of Policy and Research. Multiple official statements.

⁵ The official statements for mini-bonds are not publicly available through the Municipal Securities Rulemaking Board’s Electronic Municipal Market Access system, because they are not registered municipal securities, but they are available through the Bloomberg terminal.

taken from the “Sources and Uses of Funds” section of the official statements. Interest rates for comparison with the mini-bonds are calculated as the internal rate of return based on the total bond proceeds (principal amount less any discount or plus any premium) and the debt service schedule included in the official statement (interest and principal payments).⁶

The traditional bond costs (both issuance and interest) are compared to those of the mini-bonds issued under the same voter authorization. We estimate the cost differentials had the mini-bonds experienced the same issuance costs (as a percent of principal) and interest costs (as an interest rate) of the comparison bonds. We use an average of the available issuance costs and a weighted average interest rate when there are multiple traditional bonds for comparison. For ease of presentation and understanding, the differences in costs are presented in nominal (rather than real) terms.

Once the comparison interest rate is found from the traditional bonds, there are two alternative approaches to compare with actual mini-bond interest costs. The simplest and most direct approach is applying the weighted average comparison interest rate from the traditional bonds to the existing mini-bond structure. A disadvantage of this method is that the comparison interest rates are superimposed on the mini-bond maturity schedule. In addition, we can add the mini-bond principal amount to the closest serial bond maturity found in each comparison bond and compare the associated debt service. This approach presumes that Denver would have preserved the timing of the payoff for the mini-bond principal had it raised the funds through a traditional GO bond. The bigger issue is that semi-annual interest payments would be made with the comparison bond structures rather than the compounding that takes place with a zero-coupon mini-bond. We estimate the cost differentials using both approaches but present the results of the first because the comparison of zero coupon bonds (and its semi-annual compounding of interest) to serial bonds with semi-annual interest payments greatly exacerbates the differences in nominal debt service, resulting in even larger relative interest cost increases for mini-bonds. We also suspect that the mini-bond principal would have been proportionately distributed across the comparison bond debt service schedules if no mini-bonds had been issued, leading to even greater potential interest cost savings than reported here.

Although the traditional bond issue characteristics are not comparable to the mini-bonds (for example, in terms of maturity and, by definition, size), Denver could have absorbed the relatively small mini-bond amounts into the larger traditional offerings and had similar costs (and possibly lower

⁶ The internal rate of return is the true interest cost (TIC) for the bond issue, although here we choose to omit the issuance costs from the calculation to separately address such costs in our analysis.

issuance costs on a proportional basis). Credible issuance cost information is unavailable for the 1991, 1992, and 1999 comparison bond issues, so we use the issuance cost information from the 1990 comparison bonds.⁷

The secondary research questions about mini-bonds supporting local and nontraditional investors are answered using secondary data reported by Denver and the media. The share of mini-bond buyers that are Denver residents is used as the best available indicator of whether the focus on local investors is achieved. The residency information is available only for the three mini-bond issues in 1990, 2007, and 2014. The fundamental goal of improving access to municipal bonds by offering lower denominations is measured by a proxy for the ability of mini-bond purchasers to access traditional municipal bonds. Specifically, the average purchase size for all five mini-bond issues is calculated and compared to the traditional \$5,000 denomination for municipal bonds. The average purchase size provides a simple, high-level measure of the distribution of purchases and is suggestive of whether or not most buyers were non-traditional investors as intended. Investor-level sales information was not publicly available.

STUDY RESULTS

We address our primary research question asking how much more expensive debt financing using mini-bonds is compared to traditional municipal bonds by separately considering the estimated issuance and interest cost differentials between the two financing approaches.

Issuance Costs

Based on the issuance costs of the comparison traditional municipal bonds, substantial savings are illustrated had Denver eschewed the use of mini-bonds and instead raised the same amount of capital in existing borrowing authorized by the same bond referendums. The external costs of issuance for mini-bonds averaged 3.60% of principal compared to 0.60% for the comparison bonds,⁸ which translates into estimated potential savings ranging from 1.38% to 5.45% of the mini-bond principal. Table 4 presents the details of the estimated issuance cost differentials.

⁷ Issuance cost information for the 1990 GO bond used for comparison comes from Denver's 1990 Mini-Bond Evaluation (Charnes, 1991). The costs of issuance reported in the official statements for the 1991, 1992A, 1992C, and 1999B GO bond issues are \$85,000, \$85,000, \$100,000, and unavailable, respectively. The average costs of issuance based on the principal amounts is only 0.11%, which is far below typical issuance costs even for such large amounts of borrowing.

⁸ We weight these average issuance costs based on the size of the mini-bond and comparison bond issues.

Table 4: Issuance Cost Comparison of Denver Mini-Bonds and Comparison Bonds

Year	Principal Amount <i>a</i>	Costs of Issuance <i>b</i>	Issuance Costs (% of Principal) <i>c = b/a</i>	Comparison Bond Issuance Costs (% of Principal) <i>d</i>	Potential Issuance Cost Savings (\$) <i>e = b - (a*d)</i>	Potential Issuance Cost Savings (% of Principal) <i>f = e/a</i>
1990	\$5,888,482	\$136,000 ^a	2.31%	0.93%	\$81,261	1.38%
1992	\$3,991,500	\$139,160	3.49%	0.93% ^b	\$102,039	2.56%
1999	\$3,133,500	\$200,000	6.38%	0.93% ^b	\$170,858	5.45%
2007	\$8,860,500	\$380,000	4.29%	0.55%	\$331,267	3.74%
2014	\$12,000,000	\$350,000 ^c	2.92%	0.96%	\$234,260	1.95%

^a We use the lower costs of issuance reported in the City and County of Denver's 1990 Mini-Bond Evaluation (Charnes, 1991) rather than the \$150,000 reported in the associated official statement.

^b As noted, we use the costs of issuance from the 1990 traditional GO bond for the 1992 and 1999 cost comparisons despite being significantly higher than the issuance costs reported in the official statements. This approach is conservative because it leads to smaller potential cost savings than using the reported figures.

^c The final official statement for the 2014 mini-bonds reported costs of issuance of \$500,000. We use the lower figure of \$350,000 from the preliminary official statement because we were informed that additional legal costs from previous issues in the authorization were included in the mini-bond costs.

Interest Costs

Substantial interest cost savings were available to Denver by borrowing in a traditional manner. As a percent of the mini-bond principal, the increase in total interest costs relative to comparison rates ranged widely from 6.43% in 1999 to 33.56% in 2014 (see Table 5 for details). Although we depend on traditional Denver bonds as our primary comparison group, we also use the Bloomberg Valuation (BVAL) Benchmark Municipal Curve for AAA bonds for the respective time-to-maturity as another source of interest rate comparison with the mini-bonds. The benchmark interest rate data are available only for the three most recent mini-bond issues and provide interest rates for each mini-bond maturity specific to the day of issuance. The magnitude of the rate differences using the benchmark values is similar to those in our estimations based on the Denver bonds. The rate differential between the mini-bond and benchmark value is only 6 basis points in 1999 (4.75% vs. 4.69%), but the magnitude increases to 66 basis points for the 2007 mini-bond issue (4.75% vs. 4.09%) and to 220 basis points for the two tranches in 2014 (4.38% vs. 2.20% and 4.89% vs. 2.66%).⁹ At the

⁹ Denver GO debt was rated AA+ in both 1999 and 2007, although it carried a rating of AAA in 2014. The benchmark values, based on AAA credit quality, may therefore be slightly lower than would be experienced for an entity rated AA+. Benchmark values for AA+-rated securities were unavailable.

Year	Principal Amount <i>a</i>	Mini-Bond Interest Rate <i>b</i>	Comparison Bond Interest Rate <i>c</i>	Potential Interest Cost Savings of Mini-Bonds (nominal) <i>d</i>	Potential Interest Cost Savings (% of Principal) <i>e = d/a</i>
1990	\$5,888,482	7.17%	6.57%	\$990,921	16.83%
1992	\$3,991,500	6.00%	5.62%	\$341,200	8.55%
1999	\$3,133,500	4.75%	4.52%	\$201,385	6.43%
2007	\$8,860,500	4.75%	3.83%	\$2,214,328	24.99%
2014	\$12,000,000	4.62%	2.93%	\$4,027,078	33.56%

Note: Excel's future value function is used to calculate the nominal principal and interest costs for the mini-bonds. The rate equals either the actual mini-bond rate or the comparison rate, the number of periods represents the time to maturity in years multiplied by two for semi-annual compounding, and the present value is the principal amount at the time of sale (not the final maturity amount). We perform the calculations separately and sum them for mini-bonds with two tranches. We find the potential savings by subtracting the future value of the nominal debt service based on the comparison rate from the future value using the actual mini-bond rates.

time of the 2014 mini-bond issuance, the higher-than-market interest rates relative to certificates of deposit (even before considering the benefit of tax-exemption) were touted in the press (Murray, 2014).

Total Costs

The expectation is that the internal administrative costs of mini-bond issuance exceed those of traditional municipal bonds. Although we cannot quantify those costs here, we do present a combined estimate of the potential cost savings from not raising capital through mini-bonds for Denver. Our goal is to quantify the additional costs of mini-bond issuance. We do so by simply summing the estimated issuance and interest cost differentials previously described. Combined, the additional costs of mini-bonds are substantial, ranging from 11% to 35% of mini-bond principal as seen in Table 6. We acknowledge, though, that these cost differentials appear much less substantial as a share of the larger authorized debt totals. For example, the additional \$4.2 million in costs of the 2014 mini-bonds are only 0.78% of the roughly \$550 million in debt issued under the 2007 Better Denver Bonds program (see Table 6 for details).

We also present the true interest costs (TIC), when costs of issuance were available, and internal rate of return (IRR) calculations for each mini-bond and comparison bond in Table 7. This allows the reader to consider the difference in total costs in a single rate comparison without applying the costs of the comparison bonds to the mini-bond structure. The TICs

Table 6: Total Cost Comparison of Denver Mini-Bonds and Comparison Bonds

Year	Principal Amount	Potential Cost Savings: Issuance Costs	Potential Cost Savings: Interest Costs	Potential Cost Savings: Total (Nominal)	Potential Cost Savings: Total (% of Mini-Bond Principal)	Potential Cost Savings: Total (% of Bond Authorization)	Bond Authority (Election Years)
1990	\$5,888,482	\$81,332	\$990,921	\$1,072,254	18.2%	0.32%	\$333,340,000 (1989 & 1990)
1992	\$3,991,500	\$102,039	\$341,200	\$443,239	11.1%	0.48%	\$91,600,000 (1990)
1999	\$3,133,500	\$170,858	\$201,385	\$372,243	11.9%	0.38%	\$98,600,000 (1998)
2007	\$8,860,500	\$331,267	\$2,214,328	\$2,545,595	28.7%	0.67%	\$378,000,000 (2005)
2014	\$12,000,000	\$234,260	\$4,027,078	\$4,261,338	35.5%	0.78%	\$549,730,000 (2007)

Table 7: Interest Rate Details of Denver Mini-Bonds and Comparison Bonds

Mini-Bond Issue Comparison Year	Year/Series	Mini-Bond	Principal Amount	TIC	IRR (No Costs of Issuance)	Final Maturity
1990	1990	Yes	\$5,888,482	7.376%	7.168%	2006 ^a
	1990	No	\$74,000,000	7.036%	6.889%	2005
	1991	No	\$84,460,000	N/A	6.254%	2006
1992	1992E	Yes	\$3,991,500	6.165%	6.000%	2004
	1992A	No	\$65,000,000	N/A	5.676%	2007
	1992C	No	\$100,000,000	N/A	5.557%	2007
1999	1999A	Yes	\$3,133,500	5.215%	4.750%	2014
	1999B	No	\$95,505,000	N/A	4.524%	2008
2007	2005	No	\$77,000,000	4.161%	4.089%	2025
	2006	No	\$125,000,000	3.993%	3.939%	2025
	2007	Yes	\$8,860,500	5.061%	4.750%	2022
	2008	No	\$174,135,000	3.506%	3.455%	2025
2014	2009A	No	\$118,915,000	3.902%	3.811%	2025
	2011A	No	\$16,455,000	3.093%	2.903%	2030
	2013A	No	\$120,925,000	2.129%	2.059%	2030
	2014	Yes	\$12,000,000	4.868%	4.617%	2028 ^a

Notes: Interest cost calculations are approximate based on available debt service schedules and sources and uses of funds.
^a These mini-bonds included two tranches (see above tables for details).

and IRRs of the comparison bonds are all lower than the mini-bonds to which they are compared.

Policy Objectives

Our remaining research questions are critical, because they represent the policy justification for the increased spending to raise capital through mini-bonds. Additional costs may be justified if the mini-bonds prove an effective way to get municipal debt into the hands of local residents and improve the ability of nontraditional investors to access municipal bonds. With regard to encouraging purchases by local residents—a key goal of mini-bonds—we find that most mini-bond purchases were made by Colorado residents living outside the City and County of Denver. In 2007 and 2014, only 35% and 32%, respectively, of purchases were made by Denver residents. For the 2014 sale, approximately 272 Denver residents bought mini-bonds out of a population of more than 650,000 people. The benefits to Denver residents and taxpayers are not well-targeted considering the additional costs. The sales to residents in the most recent mini-bond issuances lag those reported for the initial 1990 mini-bond sale, where 43% of purchasers were Denver residents. For a more thorough consideration of resident purchases, we need visibility into the geographic distribution of purchase amounts and the historic share of traditional Denver bonds purchased by residents.¹⁰

We now turn to the question of expanded access for small investors to municipal debt through mini-bonds and reiterate that traditional municipal bonds sell in \$5,000 denominations. Despite the lower denominations available for mini-bonds (ranging from \$333 to \$500), the average purchase size exceeds the nominal \$5,000 mark in four of the five mini-bond issuances (see Table 8 for details). The two most recent issuances in 2007 and 2014 experienced average purchases of greater than \$10,000. We lack visibility into the actual distribution of purchase amounts and can conclude only that the sales were not dominated by small purchasers and that the average buyer may be able to access the traditional municipal bond market through other means. Granular data on individual sales is needed to better understand the distributional outcomes and evaluate the capacity of mini-bonds to improve investor access. Despite expecting a range of purchase amounts between the \$500 minimum and \$20,000 maximum limit, we present a simple simulation based on the mean purchase amount to see how sales would be distributed if the only purchase amounts were \$500 and \$20,000. Of the 850 investors, 593 could have purchased the maximum amount of mini-bonds and 257 the minimum to result in the average purchase of over \$14,000.

¹⁰ These data are not publicly available.

Table 8: Average Purchase of Mini-Bonds by Year in Nominal and Real Terms

Mini-Bond Issuance (Year)	Number of Buyers	Average Purchase (\$ Nominal)	Average Purchase (\$ 2014)
1990	1,761	3,339	6,551
1992	646	6,176	11,243
1999	600 ^a	5,217	7,428
2007	770	11,506	13,509
2014	850	14,118	14,118

^a The 1999 number of buyers is approximate (City and County of Denver, n.d.).
Sources: City and County of Denver (n.d.); North Denver News (2007); Prall (2014).

CONCLUSIONS AND POLICY IMPLICATIONS

The decision to use mini-bonds to raise capital is much more than a choice of financing mechanism. It is a political decision to accept higher costs of borrowing for perceived benefits that are much harder to value. This paper quantifies the costs and provides a preliminary look at whether the related policy objectives of focusing sales on local residents and non-traditional municipal bond investors are achieved. The resulting story is mixed. Over 25 years, Denver's elected officials have supported the use of mini-bonds to encourage a stronger connection between residents and the financing of public projects. Despite this positive intent, the use of mini-bonds has been markedly more expensive than alternative methods of borrowing and the increased costs have varied substantially over time. The history of mini-bonds in Denver is not an example of the improprieties experienced in some other areas of the municipal bond market. Rather, a portion of the additional costs is an artifact of the method of financing while the remaining cost differences appear related to a lack of flexibility in carrying out mini-bond issuances.

To reiterate, we find significantly higher costs of using mini-bonds to raise capital even when overlooking the unreported internal costs of issuance. The policy objectives, at least at a superficial level, do not appear to be fulfilled because the majority of mini-bond purchases are made by non-residents and the mean purchase amounts typically exceed minimum denominations in the traditional tax-exempt bond market. Do these results dictate a blanket recommendation that governments avoid using mini-bonds to raise capital? Based purely on cost, the answer to that question is clear, but the Denver experience provides a number of lessons to inform future consideration of mini-bond use by public officials.

The Denver experiences in 1992 and 1997 suggest that mini-bonds can be issued for about 10% higher costs relative to principal. Depending on the size of the issuance, this may be a politically palatable cost for the

publicity and policy objectives supported by mini-bonds. The latter mini-bond issues in 2007 and 2014 illustrate the dangers of setting interest rates to support the marketing component of mini-bonds (the desire to increase principal by a set amount over the life of the bond) rather than offering market rates and tailoring the size of the offering to the resulting demand. In addition, those mini-bonds were issued during low interest rate environments, which may work against this key marketing aspect of mini-bonds.¹¹

A primary lesson learned is that elected officials should be provided an estimate of the additional costs of mini-bond financing to accurately weigh their costs and benefits. Tradeoffs exist when a policy decision is made to use mini-bonds, because the additional resources required may have been directed toward other policy priorities. The central role of online processing and internet marketing in Denver's 2014 mini-bond sale suggests that technology improvements have the potential to lower costs of issuance by reducing the administrative hassles of dealing with a large number of small buyers. Yet, issuance practices that favor local residents, such as setting aside the first days of sale for walk-up customers, would improve access by the target population. Offering market interest rates, adjusted for the structure of the mini-bonds, seems essential for mini-bonds to be feasible in terms of cost. The additional costs of mini-bonds were deemed acceptable in an internal evaluation of Denver's first mini-bond experience in 1990. The Department of Revenue concluded that: "The success of the first sale suggests that there is an otherwise unfulfilled public need for this kind of investment vehicle. For this reason, and despite the high issuance cost, our conclusion is that we should continue this program" (Charnes, 1991). Given the desire of public officials to engage citizens and increase visibility and support for public projects, the improved understanding of the costs of mini-bonds seems imperative for both practitioners and academics.

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¹¹ Arguably, the need for mini-bonds has declined over time because the \$5,000 traditional denomination for municipal bonds is eroded by inflation. Similarly, single-state municipal bond mutual funds are available for many states and often require lower minimum purchases than buying individual bonds.

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